

Model Name and Version: IPM[®] (Integrated Planning Model) used for the EPA Base Case 2000 Version 2.1.

Model Type: Linear programming optimization model of the electric power and boiler sectors, producing generation, capacity, price and emissions forecasts. The emissions tracked include SO₂, NO_x, and mercury, and carbon dioxide from the electric power and boiler sector.

Developer/Home Institution:

Model inputs and assumptions: EPA. Contact: Elliot Lieberman 1200 Pennsylvania Ave, NW MC 6204N, Washington, D.C. 20460. Telephone: (202) 564-9136, email: lieberman.elliott@epa.gov.

Model engine: ICF Consulting. Contact: Juanita Haydel, ICF, 9300 Lee Highway, Fairfax, VA, 22031. Telephone: (703) 934-3373, email: jhaydel@ICFconsulting.com.

Sector Detail: Bottom-up model of all boilers and generators. Integrates electric power markets (with exogenous input electricity), fuel markets and environmental markets, without accounting for interaction with other non-energy sectors. Fuel markets for coal, natural gas, and biomass are represented in detail and equilibrium prices calculated within the model; oil prices are an exogenous input. Outputs include electric sector emissions and air pollutant allowance prices.

Regional Detail: Defined by user. EPA Base Case 2000 includes 26 electric power markets covering the 48 contiguous states of the US, with adjustments for imports. Other user-defined options include regional or control area versions.

Technology Detail: EPA Base Case 2000 includes cost and performance inputs on each vintage of electricity generation technology: coal-fired steam, oil- and/or natural gas-fired steam, natural gas-fired simple cycle combustion turbine, natural gas-fired combined cycle, nuclear, hydro, pump storage, geothermal, solar thermal, solar photovoltaic, wind, biomass, and fuel cell.

Time Period: Planning horizon and run years are user defined. EPA Base Case model run years are 2005, 2010, 2015, 2020, and 2025.

Special Features: IPM evaluates each model plant's environmental compliance strategies in the context of all other model plants' decisions and other emissions reduction options (including renewables), calculating the marginal cost of emission reduction for each pollutant. The model outputs include environmental compliance costs and allowance prices; forecasts of power sector capacity, system dispatch, emission levels and system costs; capacity additions and economic retirements; retrofit decisions; energy efficiency investment levels, impacts and costs; marginal energy and capacity prices; and fuel consumption and prices. Demand response can be simulated through a demand price elasticity.

Treatment of Renewable Energy: The model can handle any renewable resource provided it can be characterized consistent with the model's structure. Renewable energy electric generating technologies currently represented include Wind, Geothermal, Biomass Gasification Combined Cycle, biomass co-firing, Solar Thermal, Solar Photovoltaics, and Landfill Gas. Renewable energy resource characterization can include different classes for wind and solar based on cost and resource quality. Multiple vintages of technologies are allowed. IPM can also handle regional biomass supply curves. Plants can have the option of retrofitting and co-firing biomass fuels. Industrial boilers, if included, can also compete for biomass fuel. The model recognizes the intermittent nature of non-dispatchable renewable resources by modeling their output based on a seasonal, 24 hour energy MW-output profile. The model captures a technology's contribution to reserve margin as that share of installed capacity available at the time of system

peak. Data for these parameters are user defined. IPM/EPA Base Case breaks the electricity grid into 26 subregions to capture inter-regional transmission capabilities, wheeling charges and transmission losses. The model can build inter-regional transmission if cost-effective based on user input cost estimates.

Major Users/Applications: EPA is a major user of IPM. Other current and past users include FERC, Western Regional Air Partnership (WRAP), NGOs, power market developers, utilities, pipeline developers, and financial institutions. The model can be used to evaluate the impacts of command and control, and market-based policies and rulemakings affecting the power sector; to identify the least cost environmental compliance strategies for electricity generation by individual units or model plants; to generate forward electricity and emission allowance price curves and value power plant assets; to perform integrated resource planning; to evaluate alternative technologies; to forecast potential for renewable generation and CHP; to conduct fuel market analysis and to forecast fuel prices; and to perform retail deregulation analysis.

Documentation and URL: EPA Base Case 2000 documentation, <http://www.epa.gov/airmarkets/epa-ipm/> (EPA 2002).